USE OF ROMAN-TYPE CISTERNS AND SMALL DAMS

for

RAIN WATER STORAGE IN THE HIGHLANDS

of

THE BASE VALLEY OF THE MEDJERDA

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The result of the tremendous personal and economic efforts put forth by Tunisia to develop the Base Valley of the Medjerda is an example to the world of the capabilities of mankind to produce more abundantly the better things of life for themselves and their posterity. Your struggles here to develop conservation where there was exploitation; provide food where there was hunger; produce employment where there was none; will forever kindle and make warm the hearts of those who follow in your footsteps.

The relentless drive to complete the development quickly demands that daily hundreds of decisions, both big and small, must be made on a vast variety of subjects. It is the purpose of this report to suggest for your consideration a conservation practice which you may find has application to the development of the Medjerda Valley. In essence it is a practice of storing rain water in the hills by the use of numerous inexpensive small earthen dams and Roman-type cisterns.

The principle advantages of this conservation practice are three (3) which are briefly summarized as follows:

1. It would reduce the amount of water which now enters the Valley floor through stream flows in times of heavy rain. The economic aspect of this advantage would be reflected in a lowering of the current drainage costs of the Valley floor.
2. The water collected and stored in the hills represents new wealth for it can serve to increase the production of food through irrigation, or it can provide drinking water for people and livestock during the dry summer. This winter rain water stored in enclosed cisterns is safe from the thieves of sun and wind, and as the summer drought season approaches its value increases day by

day. In Libya, for example, a report indicates that 8,381 Roman-type water cisterns have recently been put into use. These cisterns have a combined capacity of 996,580 cubic meters of water. This water thus stored assists 80 percent of the livestock owners in the arid part of that country. The cost of this cistern program will be paid in five years time.

3. It offers an opportunity to utilize the work relief labor force of Tunisia to its full economic capacity. The very nature of the small dams and Roman-type cisterns is such that most of the work can best be accomplished by the use of hand labor. Another advantage in using the labor force may accrue to the laborers themselves, for by virtue of their vital participation in the conservation program they may well experience a rejuvination of their hopes for a better future. In essence the laborers may develop within themselves a wholesome conservation attitude.

The principle involved in the use of cisterns to store water has been used from pre-Roman times to the present, however the Roman-type cisterns are perhaps best known. In Libya these Roman cisterns are of two types. The predominate type was built by the following methods: First, a shaft or shafts 0.5 to 2.0 meters in depth were sunk through the limestone layer which was relatively hard. Below this surface layer the underlying limestone was considerably softer. The body of the cistern was excavated in the softer limestone. The hard surface stone then formed the cistern roof. Shapes and sizes of these cisterns vary considerably with the nature of the limestone, the size of the contributing watershed, and the needs of the original builder. Sizes vary from 30 cubic meters to 3,000 cubic meters capacity. Some are built with box-like or cylindrical shaped bodies while others consist of radiating galleries. Some have pillars to support the roof and others are cavernous in nature. Height of the

cistern body varies from 1.5 to 8.0 meters. After excavating the cistern, the builder then plastered the inside surfaces with a wet mixture of ground lime, sand and soil. The cistern was then filled with wood and fired to glaze and waterproof the interior surface. Many cisterns have numerous layers of this fired plaster.

Surface water is conveyed to the cistern by diversion terraces which either embrace a drainage area of hillside or intercepted small natural waterways.

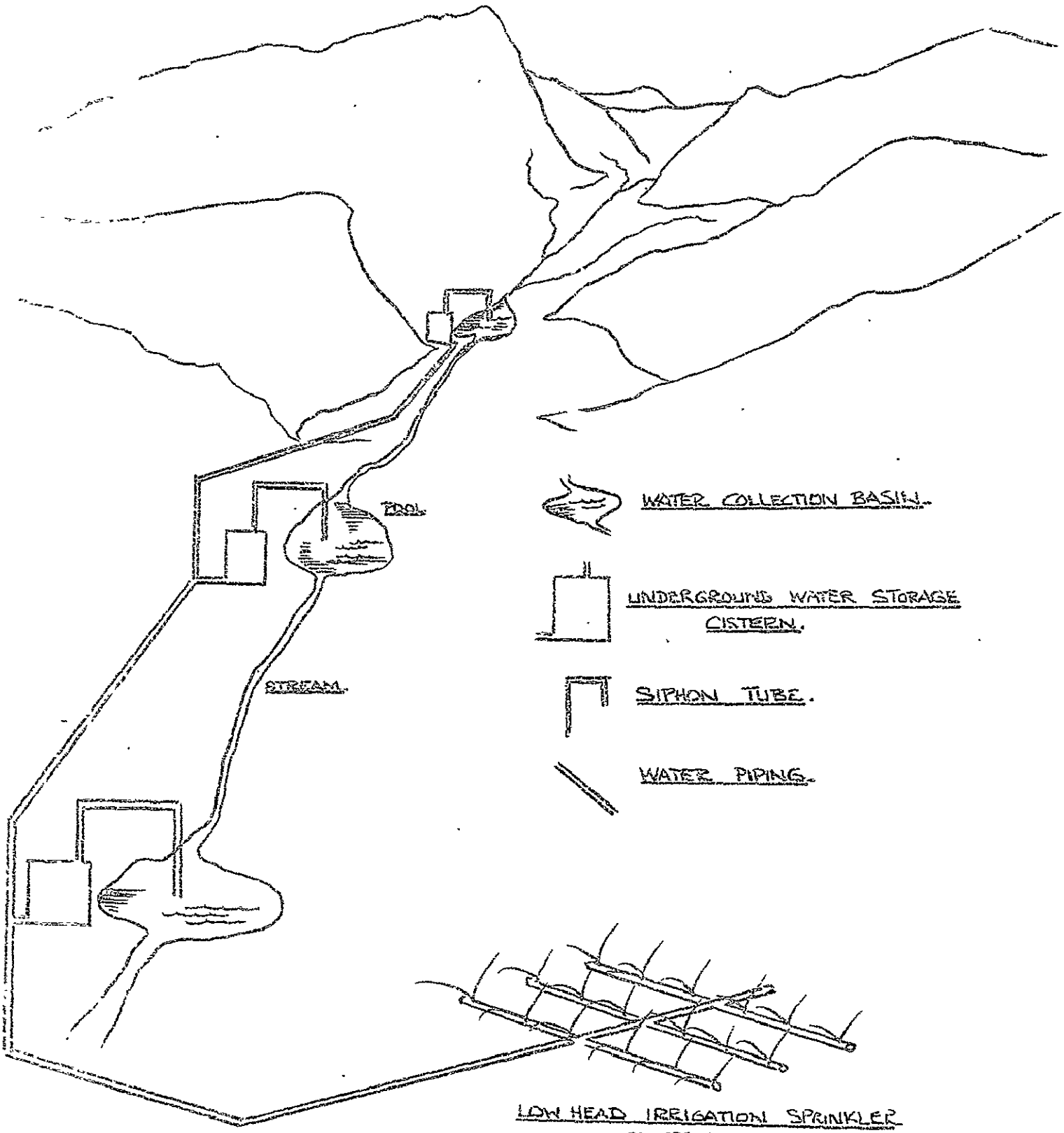
The second type of cistern varies from the first in that in some areas the limestone deposits were of less structural strength and are only deep enough to form a roof. The excavation under this roof was then lined with masonry before plastering. The weakness of the roof layer caused most of these cisterns to be built in the shape of radiating galleries.

The total material and equipment cost is small. Most of the dams would be constructed of earth and rock found at the various dam sites. Surely many such dams would be constructed where the accompanying cisterns would not be feasible. However, when the accompanying cistern was utilized its construction could be achieved at a minimum cost by applying the Roman method of construction and of sealing the interior walls of the cistern (mentioned above).

The drawing on the following page shows a series of cisterns along a stream. The cisterns are filled with water from the collection basins by means of siphon tubes. Also the cisterns themselves are connected by a pipe line which conveys the water to a lower elevation. Here due to the hydrolic head thus produced, a low head sprinkler system can be utilized for irrigation. Other alternative uses of this water pipe line would be: 1) to simply feed it into the existing irrigation canals, 2) feed it into a livestock watering trough, or 3) extend the pipe line to a small village where the water could be used by the people.

The most important aspect of this schematic drawing is that the basic design eliminates the use of motors, and all other machines

EXPLOITATION OF STREAM WATER.



LOW HEAD IRRIGATION SPRINKLER SYSTEM.

Design By
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with moving parts. Thus both the original cost of installation and the annual operational cost would be extremely low.

Here then is an opportunity for Tunisia to develop a water conservation practice which is economically sound, engineeringly feasible, and socially beneficial. The project once started will require perhaps 20 to 40 years to complete, but its value would continue for centuries. The program then is a long-term undertaking. A starting place is needed. I can think of no better place to begin than on Djebble Amar. The following reasons are given for this choice:

1. It is an isolated eroded mountain located in the central portion of the valley floor. Its position, therefore, is significant.

2. It is of sufficient size (approximately 50 square kilometers) to contribute substantial amounts of run-off water.

3. It can be treated as a complete watershed within itself.

4. Hydrology studies to determine the amount of annual run-off water are now available for a portion of the mountain.

5. Part of the mountain has already received complete soil conservation measures.

6. It is within 10 kilometers of Tunis and, therefore, easily accessible.

7. Within the mountain itself and on its outside slopes there exists numerous locations for the construction of both small dams and Roman-type cisterns.

The foregoing embodies my general thoughts on the advantages of storing rain water in the highlands of the Base Valley of the Medjerda. The basic idea is old. Its feasibility has been proven through centuries of practice. Some of the present day applications, however, are new.

Should you want additional information on this subject, please do not hesitate to ask U.S.A.I.D./Tunisia.